

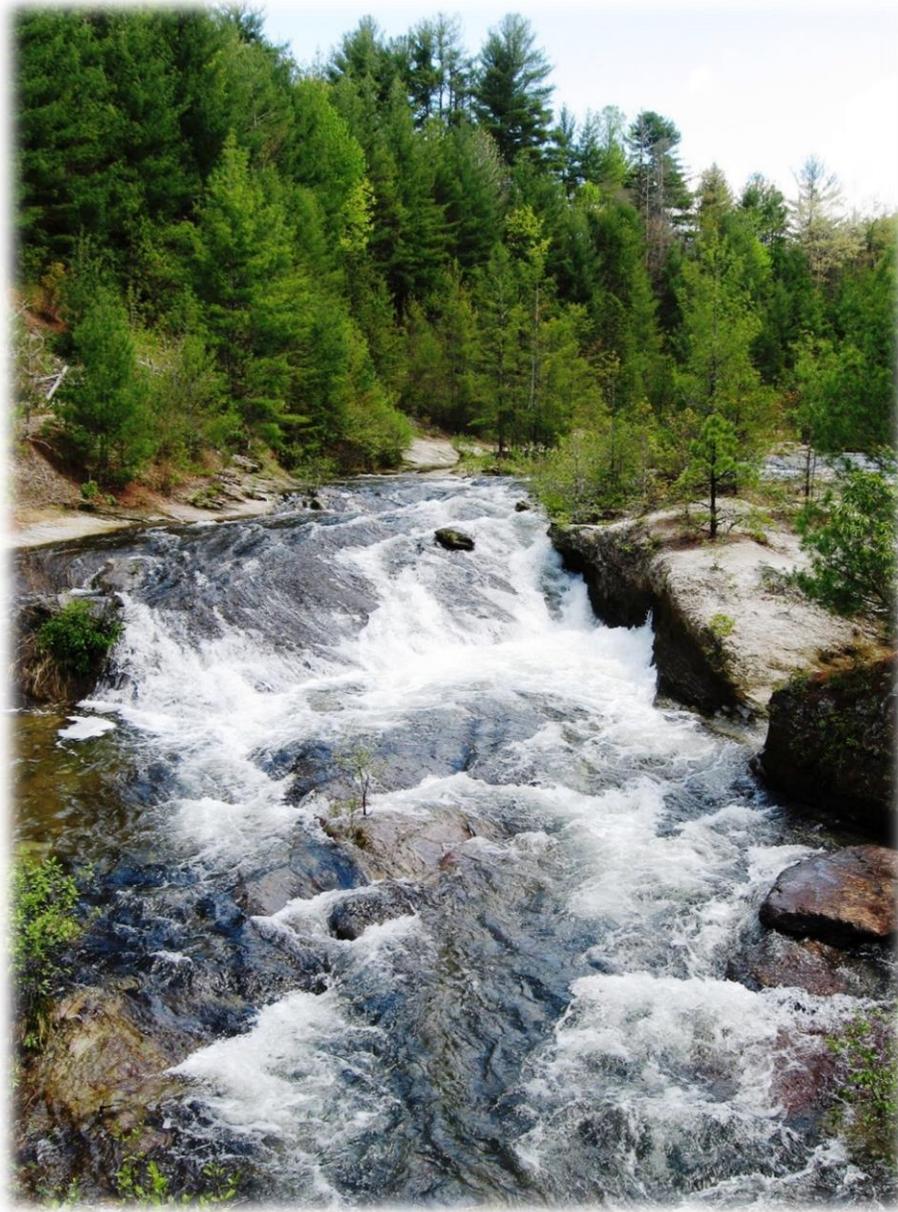
Managing Forests for Water

A Guide to Developing a Forest Watershed Management Plan

Grow, Harvest, and Renew the Forest...

Protect Healthy Watersheds...

Sustain Reliable Water Supplies.

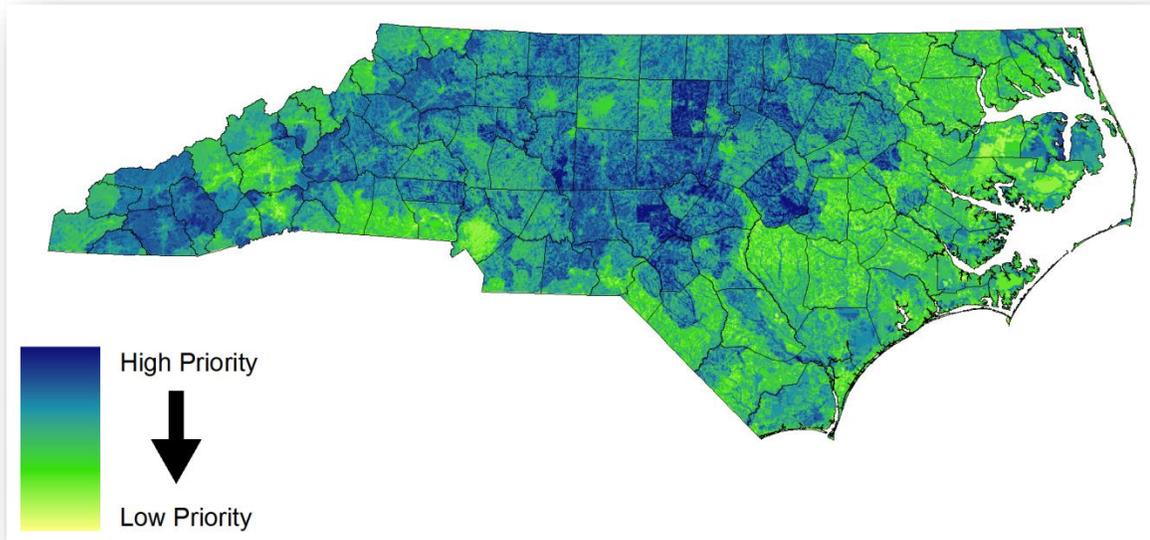


HEALTHY FORESTS = CLEAN WATER



Use Best Management Practices

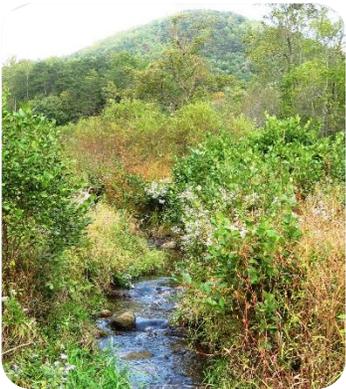
North Carolina Priority Forests for Surface Water Quality and Quantity



Map produced by D.G.Jones, North Carolina Forest Service, 2009.
 Figure 4f-8b of the *North Carolina Forest Action Plan and Statewide Assessment - 2010*. Available at www.ncforestactionplan.com

Table of Contents

- Changing Times Require New Perspectives..... 2
- Getting Water From Forests..... 2
- What the Research Shows..... 3
- Linking Healthy Forests and Healthy Watersheds..... 6
- Developing a Forest Watershed Management Plan..... 7
- Case Study: Forests & Water Quality - High Rock Lake Watershed..... 11
- Case Study: Forest Management at Jordan Lake Educational State Forest..... 12
- Appendix 1 – Additional Resource Information..... 13
- Appendix 2 – Selected Applicable References..... 14
- What do Water Supply Systems and Forests Have in Common?..... Back Cover



1. Changing Times Require New Perspectives

Forests are most often managed for the sustainable production of timber and other raw materials. Historically, these timber-based products were the primary method that people determined the “value” of a forest. Timber management is still important to sustainably supply our needs for paper, fiber, wood products and renewable energy.

In recent years, however, many social and cultural goals have shifted as a new generation of forest owners do not necessarily demand that timber revenue be the focus of owning and managing forestlands. The enhancement of wildlife habitat and conservation of “green space” in general, are often cited as the leading goals of today’s forest owners.

As the 21st century unfolds, there is a new focus which is shifting scientific, political, environmental, and economic priorities around the globe: That focus is the protection, production, and sustainability of clean, reliable, and low-cost water. The availability of water for both human use and ecological function is rapidly becoming a motivating factor in geopolitical decisions and land-use policies.

BOTTOMLINE:

While North Carolina has an abundance of both surface and ground water, the continued influx of new residents, businesses, and industries will create a demand for water that we have never before seen.

2. Getting Water From Forests

Managing forests in a way that is optimized for the site, soil, terrain, and owner’s goals will result in a healthy and sustainable forest. That forest can then continue to serve an important role in producing reliable and high quality water in our streams, lakes, and wetlands to support human population needs and ecological function.

Forests are the collection basin... the sponge... the filter... the regulator valve... the holding tank... for much of North Carolina’s freshwater after precipitation falls upon the Earth’s surface.

However, many variables can affect how rain water is received and moves through a forest, eventually reaching a stream. Differences in tree age, tree species, soils, weather patterns, and the demand for water usage all interact in a complex process that ultimately allows forests to produce reliable sources of water.

Millions of North Carolina residents receive their drinking water from forested watersheds. The positive legacy that results from growing and managing forests not only sets the course for sustaining the next generation of forest, but also for sustaining water quality and availability for the next generation of residents.

National Forests' Role in Watershed Protection

The initial federal forest reservations, which eventually became the National Forest System under the USDA-Forest Service, were established in 1897 "to improve and protect the forest within the reservation, or for the purpose of securing favorable conditions of water flows." ¹ Even back in the 19th Century, the linkage between healthy forests and healthy watersheds was clearly understood and valued. (¹ [The Organic Administration Act of 1897.](#))

In North Carolina, there is a National Forest in each major geographic region: at the coast is the Croatan National Forest; in the piedmont is the Uwharrie National Forest; and in the mountains are the Pisgah National Forest and Nantahala National Forest. You can learn more about the National Forests in North Carolina at this website: <http://www.fs.usda.gov/nfsnc>.

Our National Forests today need more care and management than ever before. The USDA-Forest Service has been hindered for nearly three decades as a result of reduced funding, a lack of resources, and recurring litigation from third-parties who attempt to intervene in the agency's management activities. Hopefully this trend will reverse, allowing foresters and other scientists to once again take the lead in managing our National Forests to support a variety of long term resource goals, including watershed protection.

3. What the Research Shows

Forest watershed hydrological research has been ongoing for over 75 years, with much of this work originating at the USDA-Forest Service Southern Research Station's Coweeta Hydrologic Laboratory Experimental Forest in the mountains of North Carolina. The following pages briefly summarize some fundamental, science-based conclusions that have been realized from decades of forest watershed research from across the eastern United States. A list of select references is included in the Appendix.

Want to Learn More About Forest and Watershed Research in North Carolina?

Coweeta Forest and nearby Bent Creek Experimental Forest are two examples where research is conducted to understand long-term trends in forest management and the effects of environmental changes upon the forest ecosystem. Visit the USDA-Forest Service Southern Research Station website to learn more: www.srs.fs.usda.gov.

Additional forestry research is conducted in North Carolina by the following organizations:

N.C. Dept. of Agriculture & Consumers Services, Research Stations: www.ncagr.gov/research

North Carolina Forest Service: <http://ncforestservice.gov>

North Carolina State University, College of Natural Resources: <http://cnr.ncsu.edu/>

Duke University, Nicholas School of the Environment: www.nicholas.duke.edu

Western Carolina University, Dept. of Geosciences & Natural Resources: <http://www.wcu.edu/>

Trees Do Not Absorb All of the Water

The climate and average rainfall conditions that we have in North Carolina allow forests that are comprised of native tree species to naturally filter and release water back into the stream systems in a consistent and reliable manner, even during droughts. Underlying geology, hill slopes, and precipitation in a forest all have a more direct influence on the amount of water that flows in streams than do the type or amount of trees that are growing there.

The cutting and removal of timber often results in a temporary increase of stream water flow within the area that was harvested. The length of time that these increases persist is widely variable, and is dependent on soils, slope, precipitation and other factors that are not directly related to forest harvesting. Often the stream flow returns to the pre-harvest conditions within 5 to 10 years.

Even though the amount of water in the streams may temporarily increase after timber harvest, many studies show that permanently converting a forest to another type of land-use will actually reduce the amount of water that is available in the stream system, over the long term, even during droughts.

Different Species of Trees Use Water Differently

Pine trees, and certain fast-growing hardwood species, have shown to utilize more water than other species of hardwoods.

High water users: pine; yellow poplar; birch; blackgum; red maple

Low water users: oak; hickory

If a hardwood forest is harvested and a pine forest is re-established in its place afterwards, you may see a long-term reduction in the amount of water that flows in the streams of the new pine forest. This change in tree species is still a better alternative than a permanent loss of a forest to other land uses. Pine tree management is compatible with protecting and sustaining water resources. The biology of pine trees simply means that they cycle more water than some hardwoods, but the many other ecological benefits of growing, sustaining, and managing a forest outweigh the water cycling effects.

Forest Cutting Does Not Cause Flooding

Forests reduce flood water impacts downstream during storms, allowing flood waters to spread out into the forest and slow down before impacting communities and infrastructure. The cutting of forests, including clearcutting, has not been shown to cause flooding or to make floods more severe.

However, additional roads in a forest can increase the intensity and severity of stormwater runoff after heavy rains, resulting in strong flows and pulses of water in streams. This is one reason to minimize the amount of roads within the forest.

Stream Buffers Protect Water Quality

Retaining relatively undisturbed buffer zones of trees, shrubs, and natural groundcover alongside streams will protect water quality from sedimentation and water temperature fluctuations.

Buffer zones need not be extraordinarily wide to be effective. Buffer zone widths ranging from 30 to 80 feet (on each side of the stream) have proven to be effective in all but the most extreme circumstances.



A stream buffer zone is seen within a clearcut timber harvest. The origin points of this stream begin within the harvest area.

Selectively harvesting trees from within the stream buffer can be accomplished, if conducted with care, and when forestry BMPs (Best Management Practices) are used. In these situations, a wider buffer zone may compensate for the increased level of disturbance that occurs inside of the buffer area.

Keeping roads, fire plow lines (for prescribed burning), skid trails, and other soil-disturbing activities out of the stream buffer zones are the most critical element in preventing sediment releases into the stream. Crossing streams with vehicles or heavy equipment should be avoided whenever possible.

Our Streams Contain a Legacy of Soil Erosion

North Carolina's history of settlement, as with most of the southern states, includes a time when nearly every acre of arable land was cleared and cultivated for subsistence farming, logging and mining; literally living off of the land's production. Also, many streams were dug out and re-located. The result is that streams and rivers across North Carolina today still contain a legacy of built-up sediment that washed into them during these historical, poor land-use practices. What does this mean for us in the 21st Century?

When a forest area is harvested, the amount of water runoff reaching the stream often temporarily increases. An increased stream flow can remobilize and stir up these legacy sediments in the streams. When we see sediment actively moving within a stream, after a timber harvest, we should not assume that the sediment washed in from the harvested area, or that the harvesting is somehow causing pollution. Instead, it is important to recognize that this historical ("legacy") sediment may have simply been released from entrapment within the stream due to the increased stream flow.

Forests Do Not Cause Nutrient Pollution

Nutrient cycling, especially for nitrogen (N), can be temporarily modified by a timber harvest, leading to an increased amount of (N) that leaches into the stream water. But the concentration levels of (N) in the water itself are still extremely low when compared with agricultural/livestock areas or wastewater discharges, and the amount of (N) is often well below the maximum allowable standards for human health. The rapid regrowth of a new forest can absorb excess (N) and stabilize the nutrient cycling process within a few years after a timber harvest. And with forests, unlike most agricultural production areas, fertilizer is not applied on an annual basis. In forests of high-volume timber production, small amounts of targeted fertilizer may be applied immediately after seedlings are planted; and once again at the mid-point of the timber's growth management schedule. Nonetheless, fertilizer application to forests, when it does occur, has not shown to be a contributing factor in nutrient pollution.

BOTTOMLINE:

The same science-based silvicultural practices that can produce a healthy “high-quality” forest which historically was only valued for its timber can also produce a “high-functioning” forest that provides a diversity of tangible values, ecological function, biological diversity, and water resource sustainability.

4. Linking Healthy Forests and Healthy Watersheds

What does it mean, to have a “healthy forest” or “healthy watershed”? This topic could produce hours of debate and volumes of pages for discussion. In this management guide, the intent of using those terms is to promote science-based practices to achieve forest management goals, which at the same time can also achieve water resource management goals.

Generally a healthy forest is:

- ✓ Free from excessive or abnormal tree mortality.
- ✓ Free from widespread, pervasive, and forest-altering damaging agents (insects, disease and invasive plants or animals).
- ✓ Relatively resilient from damage by wildfire or storms. This means the forest can tolerate some degree of impacts from natural agents, but will quickly ‘bounce back’ without the need for intervention, such as salvaging extensive areas of catastrophically damaged timber.
- ✓ Comprised of native tree species that are representative of the typical naturally-occurring ecological community that you would expect to find in that landscape setting.
- ✓ Exhibiting sustained tree growth, with little or no stagnation which can reduce the tree’s ability to fend off insects or disease outbreaks.
- ✓ Connected with other surrounding forest areas to provide wildlife habitat travel corridors, and greater overall forest tree cover on the landscape.

Generally a healthy watershed is:

- ✓ Free from pollution that exceeds the allowable water quality standards for human health.
- ✓ Covered with at least 70 percent in forest lands.
- ✓ Free from active sedimentation that comes from land-use practices.
- ✓ Comprised of streams that have:
 - Established and functioning riparian buffer zones of woody vegetation;
 - Stable stream banks and channels;
 - Hydrologically-connected floodplains;
 - Adjoining or nearby wetlands that are unaltered, intact, and functioning;
 - Abundant and diverse native aquatic life (amphibians, fish, and beneficial insects).

BOTTOMLINE:

Water quality protection results from quality management of forests. Forests need not be preserves.

While conservation of land can play a role in long-term stewardship, we should move beyond the mindset that land must only be ‘preserved’ in order to achieve the highest level of ecological function.

Forestry BMPs (Best Management Practices) are effective in protecting and sustaining water quality, but they must be used in abundance, must be used correctly, and must be maintained.

Implementation of BMPs is a core element of any forest management plan.

5. Developing a Forest Watershed Management Plan

This booklet describes some components that could be included in a forest watershed management plan for an individual tract of forest land. A forest watershed management plan should describe the general characteristics of the trees and vegetation, but a special emphasis should be placed upon other factors which describe or influence the water resources of that forest, such as:

1. Descriptions of all streams, wetlands, and water features.
2. Recommendations for establishing stream management/buffer zones.
3. Enhanced explanations of soils and slopes, focusing on drainage or water holding capacity.
4. The overall landscape and topographic position of the tract within its larger watershed.
5. Observations of current road, trail, and stream crossing conditions with suggestions for implementing Best Management Practices (BMPs) to sustain or improve the conservation of soil and water resources on the forest.
6. Long-term forest tree species management recommendations that are compatible with the forest owner’s goals, in relation to how the forest owner wishes to manage the forest for water (for example: protect water, or supply water, or reduce water).
7. Financial incentives available to the forest owner for protecting, improving, or restoring the water resources on the property.

5.1: Descriptions of Streams, Wetlands and Water Features

- Identify each stream and body of water, its name (if it has one), and its water quality standards classification (B, C, Tr, ORW, HQW, NSW, WS, and others; see Stream Classifications, Appendix 1).
- Explain what special considerations should be taken, depending upon that classification.
- Ground-truth and clearly map the location of streams, wetlands, and other water features.
- Observe the physical condition of each stream. Look for collapsing or eroding stream banks, sediment trails or runoff pathways into the stream, debris jams, and invasive species.
- Assess the overall condition of each stream to determine if the stream appears to be functioning as it should, or if it is somehow deteriorated.
- For each stream where deteriorated conditions are observed, describe those conditions, with photos, explain why those conditions are “not normal.” Suggest options to make improvements, and explain how making those improvements should benefit the overall stream and forest health. *NOTE: Work to alter a stream channel may require permitting.*
- Provide descriptions of the aquatic life (insects, fish, and amphibians) observed in each stream, and explain the value of protecting this aquatic habitat through the use of BMPs.

5.2: Recommendations for Stream Buffers

- Provide specific recommendations on how wide stream buffer zones should be, when/if forestry activities are conducted within the area adjacent to the stream. Mark a short section of stream buffer for the forest owner to visualize how much buffer is appropriate.
- Identify any vegetation management issues in the buffer zones that may warrant action (invasive species, prescribed burning, tree-stand improvement, afforestation, selective harvest).
- Explain any rules that may apply for establishing mandatory stream buffer zones along each identified stream or water channel on the property.

5.3: Explanation of Soils and Slopes

- Briefly discuss the different soil types that are found on the tract. Explain the drainage, infiltration, and water-holding capacity of each soil.
- Examine and explain locations in which soils may influence how water runoff or sub-surface water may move across the property. Incorporate recommended BMPs or other measures that may be appropriate when forest management work is conducted on those soils or slopes.
- Review and interpret operational considerations from the USDA-NRCS soil survey. These include equipment limitations, rutting potential, log deck site locations, site index, and other forestry-related factors that may be appropriate for recommended forest management work.

5.4: Landscape and Topographic Position

- Identify, with maps, the relative location of the property within its watershed. Explain how and where stream water moves onto, or off from, the property.
- Explain how activities conducted on this parcel can positively (or negatively if not done right) influence water conditions further downstream; and conversely, forest and water resource management on this tract may help to attenuate or improve the water quality conditions which may be flowing onto the tract from upstream.
- If the tract is within a water supply watershed, explain the importance of protecting the water resources for that water supply.

- Explain how topography influences forest and water management with respect to aspect (north, south, east, west facing slopes) and elevation. These topographic factors also have an influence on water cycling between the soils and the forest. For example, north facing slopes are typically moist, with deeper soils that can absorb more rainfall, while south or west facing slopes are typically drier, with shallower soils, where runoff can more easily wash away topsoil.

5.5: Observe Current Road, Stream Crossing, and Trail Conditions

- The primary purpose of a forest watershed management plan should be to protect and sustain water resources. Therefore, detailed attention should be paid to this section of the plan, in an attempt to influence the forest owner to take actions that place water resource protection as the top priority, even if it means sacrificing other benefits (such as foregoing the convenience of multiple stream crossings, or additional/wider roads or trails).
- Take detailed observations and photos of stream crossings, roads, and trails.
- If there are problems, describe them, explain why it is a problem and offer solutions.
- Include specific BMPs or references to BMP measures that can be implemented to either resolve a problem, or maintain an existing good condition.
- Provide an estimate of costs that would be incurred to resolve identified problems.
- Identify roads, trails, or stream crossings that can be permanently closed, removed or retired. Explain the benefits to water resources and long-term cost savings that can be realized by properly decommissioning (retiring) them, and not having to maintain them.



Examine locations where roads or trails intersect or get close to streams. Identify problems and offer solutions that follow BMPs. The left photo shows a culvert that is too small to carry the storm flow of stream water. An improved ford may be a better solution on this lightly-used trail. The right photo shows a large culvert that has collapsed into the stream channel, and requires repair.

Above all else, ask the question: Is the stream crossing really necessary?

5.6: Forest Management Recommendations for Water Resources

Based upon the forest owner's goals, provide suggested opportunities to conduct forest management that can achieve water-related objectives, while still adhering to sound silviculture. For example:

- If the goal is to increase the supply and availability of water, consider long-term species conversion to oaks, hickories, or other native tree species, which cycle less water.
- If the goal is to moderate the amount of seasonal stream flow, consider long-term species conversion to pines, yellow poplar, or other native tree species, which cycle more water.
- If the goal is to go above and beyond in the protection of existing water resources, identify alternative methods of implementing forest management practices that may offer lower-risk, and lower-impact in lieu of traditional methods, such as:
 - Avoid crossing streams by foregoing harvesting, or by accessing the timber from the other side of the stream whenever possible.
 - Do not construct any additional roads on the property.
 - Establish wider-than-needed stream buffers, and/or stream buffers with restricted entry and limited disturbance.
 - Require the use of low-ground-pressure equipment during any logging.
 - Install hand-lines, mowed lines, disked lines, or mulched lines for prescribed burning instead of bladed or plowed lines.
 - Only apply fertilizer if a soil sample analysis indicates that nutrients are limiting for the desired forest tree species. Apply fertilizer sparingly.
 - Conduct site prep in a way that avoids disturbing the soil.

Usually, these alternative methods cost more to implement than the traditionally-available methods, and this cost differential should be explained for the forest owner, but balanced against the potentially higher level of soil and water resource protection.

5.7: Financial Incentives

- Identify potential cost-share subsidy programs that may offset some costs of recommended management activities. Include a brief description of each program, and provide a weblink or brochure that more fully describes eligibility, conditions, and program benefits, including appropriate agency contact information to pursue enrollment or sign-up.
- Identify if there are any potential areas on the property in which the forest owner could receive market-based compensation for protecting, enhancing, or restoring water resources. Examples include conservation easements, stream or wetland compensatory mitigation banking programs, riparian/stream buffer programs, conservation tax credits, water quality trading credits, and other opportunities.

BOTTOMLINE:

A forest watershed management plan should include recommendations that are founded upon sound science and silviculture, but it may not focus solely on maximizing timber production.

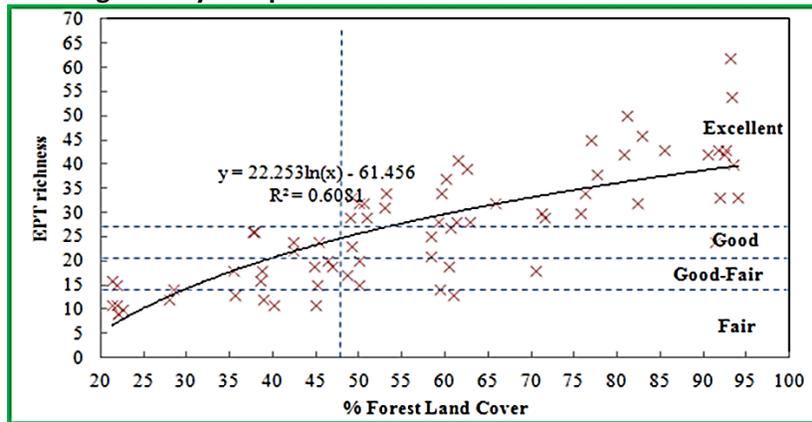
A forest watershed management plan should be more inclusive of the 'big picture' of where the tract lays in the watershed landscape, be more detailed in its assessment of the water resources, and offer alternative options to the forest owner for managing their forest in a way that goes above and beyond the 'normal' level of watershed conservation that is typically described by the average timber-focused management plan.

In this scenario, it is assumed that the forest is primarily being managed for overall water quality protection, water conservation, and/or water supply availability.

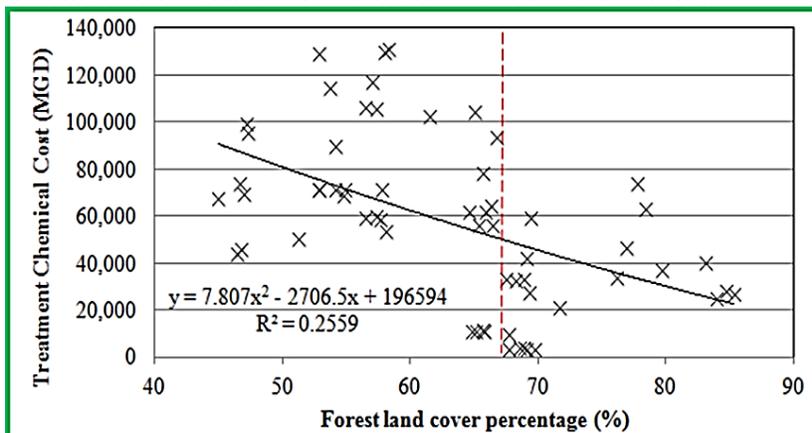
Case Study: Forests & Drinking Water - High Rock Lake Watershed

The High Rock Lake watershed is located in the upper half of the Yadkin-Pee Dee River basin of North Carolina. A study conducted by UNC-Charlotte for the N.C. Forest Service (NCFS) found a positive connection between the amount of forest in a watershed, and overall positive attributes of watershed health. More information about this and other studies can be found in the 'Water Quality' section of the NCFS website, ncforestservic.gov.

Watersheds with 50% or more forest land cover exhibited more robust populations of beneficial aquatic insects, which is a generally accepted measure of overall stream health and water quality.



Watersheds with 70% or more forest land cover demonstrated a trend of lower costs to treat drinking water.



Case Study: Forest Management - Jordan Lake Educational State Forest



Jordan Lake is the water supply source for nearly 250,000 customers in central North Carolina.

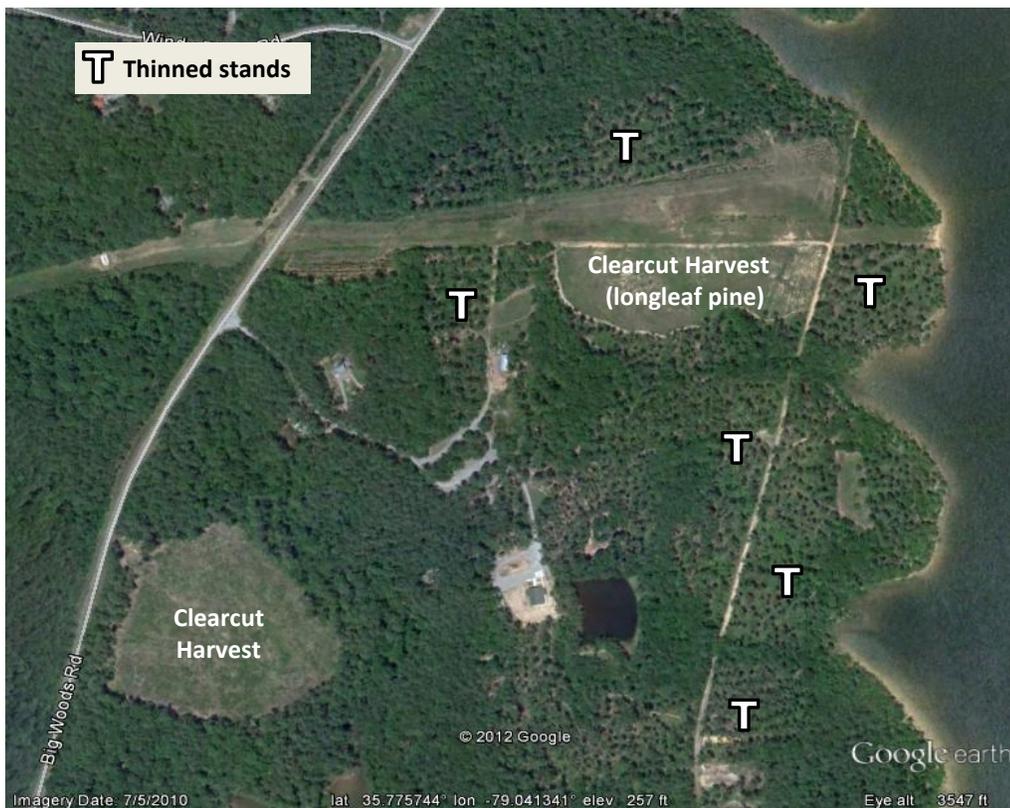
The top aerial photo is from 2004 and shows many stands of pine forest that are overcrowded, stagnant, and in need of thinning or a renewal harvest.

The bottom aerial photo is from 2010 after multiple thinnings and harvests. Two areas were clearcut, with the northern block restored to a longleaf pine and native grass savannah. The southern block was replanted with native loblolly pines.

Note the timber areas along the lakeshore that were thinned. The healthiest, best quality trees were retained, providing them with more room to grow.

As a result of the thinning, wildfire risk is reduced and wildlife habitat is much improved, especially for bald eagle and other birds-of-prey.

Recurring prescribed fire can now be used to manage the pine stands that were thinned. Using fire will maintain native grasses for wildlife cover and forage.



Appendix 1 – Additional Resource Information

Conservation Buffers: Design Guidelines for Buffers, Corridors, and Greenways.

USDA-Forest Service. Southern Research Station. Publication Number GTR-SRS-109.

<http://www.treesearch.fs.fed.us/pubs/33522>

Environmentally Sensitive Maintenance Practices for Dirt and Gravel Roads.

USDA-Forest Service. San Dimas Technology and Development Center. Publication No.1177 1802P.

http://www.fs.fed.us/t-d/php/library_card.php?p_num=1177%201802P

Forests and Water. USDA-Forest Service, Southern Research Stn., Center for Integrated Forest Science.

<http://www.srs.fs.usda.gov/cifs/>

Low-Water Crossings: Geomorphic, Biological, and Engineering Design Considerations.

USDA-Forest Service. San Dimas Technology and Development Center. Publication No. 0625 1808.

<http://www.fs.fed.us/eng/pubs/pdf/LowWaterCrossings/index.shtml>

National Management Measures to Control Nonpoint Source Pollution from Forestry.

U.S. Environmental Protection Agency. Publication No. USEPA-841-B-05-001.

<https://www.epa.gov/nps/national-management-measures-control-nonpoint-source-pollution-forestry>

North Carolina Forest Action Plan - 2010. <http://www.ncforestactionplan.com/>

North Carolina Forestry Best Management Practices Manual to Protect Water Quality.

http://www.ncforestservice.gov/water_quality/bmp_manual.htm

Riparian Forest Buffers: Function and Design for Protection and Enhancement of Water Resources.

USDA-Forest Service. Northeastern Area State & Private Forestry. Publication No. NA-PR-07-91.

<https://www.fs.usda.gov/naspf/publications/riparian-forest-buffers-function-and-design-protection-and-enhancement-water-resources>

Southeastern Partnership for Forests and Water: <https://southeasternpartnership.org/about/>

Southern Forest Futures Project. USDA-Forest Service. <http://www.srs.fs.usda.gov/futures/>

Stream Classifications for North Carolina. NCDEQ-Division of Water Resources.

<https://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/classifications>

Trees and Stormwater: <http://treesandstormwater.org/>

Urban Watershed Forestry Manual. USDA-Forest Service and Center for Watershed Protection:

Part 1: Methods for Increasing Forest Cover in Watersheds

https://www.fs.usda.gov/naspf/sites/default/files/urban_watershed_forestry_manual_part1.pdf

Part 2: Conserving and Planting Trees at Development Sites

<https://www.fs.usda.gov/naspf/publications/urban-watershed-forestry-manual-part-2-conserving-and-planting-trees-development-site-0>

Part 3: Urban Tree Planting Guide

<https://www.fs.usda.gov/naspf/publications/urban-watershed-forestry-manual-part-3-urban-tree-planting-guide>

Appendix 2 – Selected Applicable References

2015. *Effects of Timber Harvest on Water Quantity and Quality in Small Watersheds in the Piedmont of North Carolina*. J.Boggs and others. USDA-Forest Service. <https://www.fs.usda.gov/treearch/pubs/49155>
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2013. *Effects of Soils on Water Quantity and Quality in Piedmont Forested Headwater Watersheds of North Carolina*. J.Boggs and others. USDA-Forest Service. <http://www.srs.fs.usda.gov/pubs/42934>
2013. *The Effectiveness of Streamside Management Zones in Controlling Nutrient Fluxes Following an Industrial Fertilizer Application*. J.Secoges, and others. Virginia Tech Department of Forestry. USDA-Forest Service Publication GTR-SRS-175-405. <http://www.srs.fs.usda.gov/pubs/43665>
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2012. *Can Forest Watershed Management Mitigate Climate Change Effects on Water Resources?* J.Vose and others. USDA-Forest Service. Publication SRS-353. <http://www.srs.fs.usda.gov/pubs/41261>
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2010. *Flat Branch Monitoring Project: Stream Water Temperature and Sediment Responses to Forest Cutting in the Riparian Zone*. B.Clinton, J.Vose, and R.Fowler. USDA-Forest Service. Publication SRS-51. <http://www.srs.fs.usda.gov/pubs/36097>
2010. *Quantifying Structural and Physiological Controls on Variation in Canopy Transpiration Among Planted Pine and Hardwood Species in the Southern Appalachians*. C.Ford, R.Hubbard, and J.Vose. USDA-Forest Service. <http://www.srs.fs.usda.gov/pubs/36108>
2004. *Fifty Years of Forest Hydrology in the Southeast*. C.R. Jackson, and others. USDA-Forest Service. Chapter 3 of “A Century of Forest and Wildland Watershed Lessons.” Published by Society of American Foresters. <http://www.srs.fs.usda.gov/pubs/21312>

Acknowledgments and Disclaimers

The North Carolina Forest Service is an equal opportunity employer. Its programs, activities, and employment practices are available to all people regardless of race, color, religion, sex, age, national origin, handicap or political affiliation.

There may be other data, research studies and references that either support, or refute, the information conveyed in this booklet. Best professional judgment is necessary whenever a management plan is prepared or implemented for a forest owner.

1,000 copies of this public document were printed at a cost of \$_____, or \$_____ per copy. Reprinted July 2018.
Cover Page Photo: Outfall stream channel from Lake Julia on DuPont State Recreational Forest, Transylvania County, NC.

What do Water Supply Systems and Forests Have in Common?

Much of the emphasis for protecting water quality and understanding the value of a forest watershed management plan comes from the need to supply reliable and affordable water for human consumption. Some people claim that to maximize the protection and supply of water, forests should not be managed, but instead should be restricted preserves where no activity occurs. In all but the most extreme cases, this mis-guided intent to 'preserve' the forest is not appropriate. Management of forests in a watershed can be compatible with sustaining a high quality and abundant supply of water. The key to success is to plan, design, invest in, implement, and maintain forestry BMPs (Best Management Practices).

One way to think about the need for management is to think of forests as systems, just like the water supply system that brings water to the faucet in your home. Because the system is comprised of many parts and complex inter-connections, there is a need to effectively manage the system in a way that allows it to operate smoothly with minimal disruptions or failures. The table below attempts to show how common terms used in the management of water supply systems are equally applicable to the need to manage forest systems.

Infrastructure
Water System: reservoir, pumps, tanks, pipes, filtration facility, lift stations
Forest System: forestland, trees, soil, roads, trails, wildlife, water, mineral resources
Asset Management
Water System: rebuild worn out pumps, replace out-dated pipes, dredge built-up reservoir silt
Forest System: thinning, harvesting, prescribed burning, reforestation, wildlife food plots
Operations & Maintenance (O&M)
Water System: read meters, fix leaks, paint storage tanks, replenish treatment chemicals
Forest System: maintain roads, clear blocked culverts, control weeds, manage wildlife
Inventory Control
Water System: make/model of pumps, types of pipes, overall system capacity to produce water
Forest System: forest age, tree species, size of trees, insect & disease survey, soil productivity index
Life-Cycle Replacement
Water System: replace components before they fail, to maintain uninterrupted operations
Forest System: harvest areas of trees in the forest and replenish them with new seedlings
Capital Improvement (CIP) or Capital Expenditures (Cap-Ex)
Water System: extend service into new areas, acquire new remote-sensing meters
Forest System: acquire more land, invest in reforestation, or improve wildfire control capabilities
Loss Control
Water Systems: video surveillance, key cards, facility fences
Forest Systems: boundary survey, marked property lines, fences, gates, routine patrols
Risk Management
Water Systems: continuity of operation plans, ISO, operator certification programs
Forest Systems: BMPs (Best Management Practices), forest certification programs, fire risk assessment

Bottomline: You would not expect a water supply system to simply be left alone as 'hands off' with no routine maintenance or improvements made. Taking a 'hands off' approach to forest systems is equally inappropriate, even when considering protection of watersheds or source-water.



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